Section 5

K–20 Partnerships in Science, Engineering, and Technology

Introduction

Los Alamos National Laboratory supports innovative and partnership-driven K-20 programs in science, mathematics, engineering and technology. These programs are designed to significantly improve teaching and increase achievement in science and mathematics for students throughout northern New Mexico and nationwide.

The security of the Laboratory and the Nation depends on an increasing awareness and understanding of the importance of the scientific endeavor. To this end, the successful K-20 partnerships shown in this section serve as models to improve mathematics and science achievement and identify and develop the potential to succeed in science, engineering, and technology at all societal levels.

The Electromechanical Technology Program

Program Description. In January 1997, the Los Alamos Neutron Science Center (LANSCE) at Los Alamos National Laboratory (LANL, the Laboratory) developed and launched the Electromechanical Technology Program (EMTP) to train students to enter the technical work force. The program—which has been very successful—is co-sponsored by LANSCE and the University of New Mexico-Los Alamos (UNM-LA).

Program participants are enrolled in course work leading to a certificate in electromechanical technology. Course work emphasizes providing participants with a foundation of academic and technical knowledge that will enable them to perform successfully as technicians in a variety of electromechanical environments. Students are assigned to work under the guidance of Laboratory technical staff members or senior technicians. A portion of each student's workday is spent at UNM-LA attending academic courses specially designed to relate to participants' jobs.

To successfully carry out the Department of Energy (DOE)/Defense Programs (DP) mission and achieve the Laboratory's institutional goals, it became imperative to expand the EMTP program beyond LANSCE. EMTP is now a Laboratory-wide initiative, and EMTP has grown to include six additional divisions—Physics, Engineering Sciences and Applications, Dynamic Experimentation, Materials Science and Technology, and Spallation Neutron Science.

The program has been described repeatedly at the New Mexico Legislature as a notable success in the school-to-work program—a statewide and nationwide educational initiative. The number of students enrolled in the program has doubled since 1997. About 14 people enter the program each year.

Performance Goal, Objectives, and Milestones. Program goals and objectives include helping individuals to develop the critical skills required for employment at the Laboratory, and helping them to develop skills that make them marketable in the local communities in northern New Mexico and throughout the state.

Upon successful completion of the two-year training program, students are awarded a certificate and are offered continued employment at LANL (subject to positive evaluations and funding).

The success of the program is measured annually by the number of applicants, the number of students who graduate from the program, the number of graduating students who are offered University of California (UC) regular or limited-term positions at LANL, and the number of graduating students who are offered similar positions in northern New Mexico and throughout the state. Feedback from sponsoring divisions and mentors also plays a role in evaluation of the program.

The goals and objectives of EMTP are directly aligned with two of the Laboratory's published institutional goals: No. 6, "to deliver neutrons and protons safely and reliably for all LANSCE users," and No. 7, "to refocus our hiring on entry-level and strategic hires, with a simultaneous emphasis on diversity in all forms (diversity of people, fields, and technical ideas)." The program also aligns directly with Critical Skills Area #8, "Lasers, Pulsed Power, and Accelerators."

Since the program began in January 1997, 42 students have participated; 27 have graduated; and 25 of the 27 graduates have been placed in UC regular or limited-term positions at the Laboratory. Milestones for FY02 are shown in Table 32.

Table 32. Milestones for FY02	
Date	**Activity**
1/97	Offered first year of classes; 10 students participated.
8/97	Offered second year of classes; 10 students participated.
8/98	Offered third year of classes; 10 students participated.
1/99	Graduated first class; six students received certificates.
5/99	Graduated second class; eight students received certificates.
8/99	Offered fourth year of classes; eight students participated.
5/00	Graduated third class; eight students received certificates.
8/00	Offered fifth year of classes; six students participated.
5/01	Graduated fourth class; five students received certificates.
8/01	Made offers to 16 students.
5/02	Graduated fifth class; four students participated.
8/02	Made offers to approximately 30 students.
5/03	Anticipate graduating sixth class; 26 students participating.

Highlights of This Year's Accomplishments. A total of 30 students participated in EMTP during FY02. Four students graduated from the program in May 2002. All were offered regular, full-time UC positions. Ethnicity and gender are broken down in Table 33.

Student Comments. Students are enthusiastic about the program, and their comments reveal what it has done for them and for the Laboratory.

Joe Strotman was a baker in the grocery business when he noticed an advertisment in the local paper for the Electromechanical Technology Program. He was tired of long hours and relatively few days off, and the ad made him consider for the first time that perhaps he might be able to get a good job at the Laboratory without having an extensive background in science.

He applied, was accepted, and completed the program. Now, five years later, he works in the High Power Microwave, Advanced Accelerator and Electrodynamic Applications Group (NIS-10).

"I can feel good about something (now)," he said, "whether it's contributing to the advancement of science or something else. I don't want to just collect a paycheck."

Adam Pacheco, a 2000 graduate of Española Valley High School who lives in Truchas, New Mexico, applied to the program when a friend told him about it. Now he has finished the program, has a permanent position in the Electronic and Electromechanical and Device Group (MST-11), and is thinking about earning a bachelor's degree in electrical engineering.

"The thing I liked most about the program," Pacheco said, "was the fact that it is a cooperative program between LANL and UNM-LA. I liked being able to apply skills that I learned at school on the job and vice versa." He said he had a positive experience with his mentor in the program. "He affected my work ethic by teaching me to take things slowly and work hard at whatever I attempt to accomplish," Pacheco said.

Dion Martinez, a 1999 graduate of Pojoaque High School who is married, has a son and a daughter, and lives in Española, entered the program because the UNM-LA staff told him about it. He graduated from the program in May 2002.

"It led me to a full-time job … and helped improve my education skills as well," he said. Asked what he liked best about the program,

Table 33. Ethnicity/Gender Breakdown of Participants in FY02					
Caucasian Male	**Caucasian Female**	**Hispanic Male**	**Hispanic Female**	**Native American Male**	**Native American Female**
5	1	19	1	2	2

he said, "Everything is great about the program—working, going to school, getting paid to go to school, and working with others in the program." Now he is also thinking about earning a bachelor's degree in electrical engineering.

David Lujan of the Neutron and Nuclear Science Group (LANSCE-3) is a student in the Electromechanical Technology Program. The Detector for Advanced Neutron Capture Experiment (DANCE) will be used to develop an understanding of the synthesis of chemical elements in stars, the burnup of nuclear waste, and the behavior of nuclear explosives (based on archived data). David is helping to get DANCE online (Figure 74).

"It's a symbiotic relationship. I help the group, and it pays for school."

A former environmental science major, Lujan plans eventually to pursue a bachelor's degree in electromechanical engineering.

Figure 74. David Lujan displays a barium fluoride crystal that is part of the Detector for Advanced Neutron Capture Experiment (DANCE).

2002 Expanding Your Horizons in Science and Mathematics Los Alamos Conference

Sponsored by the Northern Chapter, Los Alamos Women in Science (LAWIS), New Mexico Network for Women in Science and Engineering (NMNWSE)

Program Description. Expanding Your Horizons in Science and Mathematics™ (EYH) conferences, the flagship programs of the Math/Science Network, are designed to nurture girls' interest in science and mathematics courses and to encourage them to consider science- and math-based career options such as engineering, computer science, and biometrics.

The Math/Science Network created the first EYH conference at Mills College in 1976. Today, EYH conferences are held in more than 105 locales. More than 575,000 young women have participated in these conferences. Many of these conferences conduct concurrent programs for parents and educators so that they may more effectively support young women and their technical aspirations.

A typical conference is attended by young women from middle schools and high schools. Each conference schedule includes two varieties of workshops and a keynote address encouraging girls to persist in mathematics and science courses. In some of the workshops, young women participate in hands-on learning experiences led by women scientists, mathematicians, and engineers. In other workshops, role models share career awareness information and discuss job satisfaction, necessary education, and descriptions of a typical day on the job.

The Math/Science Network licenses and coordinates this network of EYH conferences. It initiates local-site conferences and provides them with technical assistance and conference and planning materials as well as support services, including coordinated publicity and public relations posters and buttons. The network also provides a "networking" link between sites.

In 2003, many conferences will hold their programs on March 8 in honor of International Women's Day.

Performance Goal, Objectives, and Milestones. The purpose of EYH is to educate and inspire girls in junior high school and high school to get involved in mathematics, science, and technical fields. The workshops are designed to provide students with an opportunity to meet and form personal contacts with women already working in these fields.

All students who attend an EYH conference are required to have an adult sponsor. However, the sponsor is not required to accompany the student to the conference. Sponsors who do accompany students may not attend the student workshops (unless they are needed to assist a student with a disability or similar exceptional circumstances). EYH wants to allow more room for the participants. A separate Teacher Conference is provided for accompanying adult sponsors.

To recruit students for the annual EYH conference, organizers send a complete package of registration materials to each of the public and private schools in northern New Mexico that serve grades eight through 10. In addition, all registration information is run on the website of the Northern Chapter, Los Alamos Women in Science (LAWIS), and advertisements are placed in local newspapers.

The evaluation forms for the 2002 EYH Conference posed two questions intended to make it possible to assess whether the program met its

goals. The first question asked, "Did this conference positively influence or positively reinforce your decisions concerning the number of math and science classes you plan to take in the future?" Eighty-seven percent confirmed that it had; only 12% indicated that it had not.

The second question asked, "Did this conference positively influence your attitude toward math and science?" Seventy-five percent of the students confirmed that it had; 25% said it had not.

The responses to evaluation questions proved that the 2002 EYH Conference was a success. The teenage girls who attended said the program expanded their scientific horizons.

Highlights of This Year's Accomplishments. The Northern Chapter of the New Mexico Network for Women in Science and Engineering (NMNWSE, also known as Los Alamos Women in Science [LAWIS]) held its annual Expanding Your Horizons Conference on March 13, 2002.

About 100 students from two dozen local school districts participated in various workshops demonstrating the importance of mathematics and science. Female scientists, engineers, and professionals from Los Alamos National Laboratory (the Laboratory) and the Los Alamos area led the workshops at the Laboratory and the Los Alamos Research Park.

The girls were randomly placed in groups to interact and experience the workshops with new people. The groups were assigned to make a functioning boat out of foil and make an advertisement to market their product. Team 8's model boat is shown in Figure 75. Each group attended two workshops, one in the morning and one in the afternoon.

Workshop topics ranged from understanding the biology of tuberculosis to creating a presence on the web. Topics included crystal growth, "Designing the Ultimate Motion Machine" (see Figure 76), dynamic material testing, Fun Properties of Fluids" (see Figure 77), health and wellness in the workplace, making "ooey gooey polymers," preserving the past, robotics (see Figure 78), scanning electron microscopy, "Tails of a Veterinarian," and "Toys and Science."

Christine Crowder, a tenth-grade student at McCurdy High School, is interested in engineering and graphic design. Crowder attended the workshop on the properties of fluids. Crowder said later, "The learning process of the workshops introduced me to these disciplines and will be helpful to me in the future. It isn't boring like people think; it's actually really interesting and fun. More girls should get involved."

Toni Marie Sprague, a freshman at Coronado High School, said, "I want to become a veterinarian because I love animals. My love for animals got

Figure 75. Team 8, "The Beautiful Boats," tested their model boat with pennies in order to determine how well it would stay afloat. Left to right are Erika Velasquez, an eighth-grade student from Coronado Middle School, Jessica Purdy, a tenth-grade student from Espanola High School, Rosemary Montoya of Ecology (ESH-20), Heather Martinez, an eighth-grade student from Rock Christian Academy, Lysetta Romero, a tenth-grade student from Mesa Vista High School and Felicia Gallegos an eighth-grade student from Saint Francis Cathedral School. Inset photo: "The Beautiful Boats" model boat held 100 pennies without sinking.

Figure 76. Christine Crowder, left, a tenth-grade student at McCurdy High School, Victoria Roybal, center, an eighth-grade student at Española Middle School, and Amber Lovato also an eighth-grade student at Pojoaque Middle School have a hands-on experience in the "Fun Properties of Fluids" workshop presented by Katherine Prestridge of Hydrodynamic Applications (DX-3).

Figure 77. Presenter Stephanie Pendergrass, kneeling, of the Aspen Medical Clinic, Cecily Marroquin, an eighth-grade student of Los Alamos Middle School, Cassandra Gonzales, an eighth-grade student of Peñasco Middle School, Amanda Romero, a ninth-grade student of Victory Christian Academy, and Jessica Purdy, a tenth-grade student of Española High School, time themselves pushing a 100-year-old bike to compare to the time it takes to walk the same distance in the workshop, "Designing the Ultimate Motion Machine."

Figure 78. Marielle Remillard, 13, of Los Alamos Middle School, assembles a motor-control circuit. Inset photo: One of the sample robots served as an example for the teenage girls who were working to build circuits used in motion control.

me interested in math and science because I need to know these subjects to take better care of my future patients."

Kyndra Garcia, an eighth-grade student at Pojoaque Middle School, said she wants to be a crime-scene investigator. "It is really interesting how math is involved with being a doctor," Garcia said, adding that the workshops also taught her more about engineering.

Evaluation. Overall evaluations of morning and afternoon workshops were similar, as Figures 79 and 80 show.

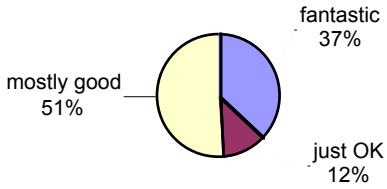


Figure 79. EYH morning workshop evaluation for content.

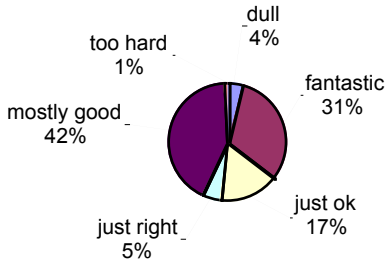


Figure 80. EYH afternoon workshop evaluation for content.

A majority of the girls gave the "team-activity content" grades of "mostly good" or "fantastic." A strong majority of them—85%— rated the difficulty "just right."

Team posters from the EYH02 team activity (the boat-making contest) can be viewed at http://t12www.lanl.gov/home/lawis/EYH02/Posters/index.htm. Student pages from the EYH02 website workshop can be viewed at http://t12www.lanl.gov/home/lawis/EYH02/StudentPages/index.htm.

Keynote Speaker. The keynote speaker for this year's conference was Missy Cummings, author of "Hornet's Nest: The Experiences of One of the Navy's First Female Fighter Pilots." Her talk, "Breaking Through Barriers," emphasized the values of believing in yourself and rising to the challenge. She spoke about her experiences as an aviation pioneer, her transformation to a woman of strength, and the importance of conquering fears.

Demographics. The chart below shows the declared ethnicity of conference attendees (see Figure 81). The demographics of this program have been similar for the past several years, varying only by a small percentage.

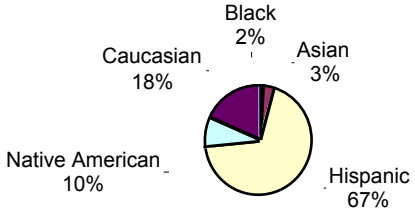


Figure 81. EYH 2002 ethnicity.

Most of the girls were in the eighth grade (44%), ninth grade (29%), or tenth grade (24%). The remaining students were eleventh and twelfth graders (3%) (see Figure 82).

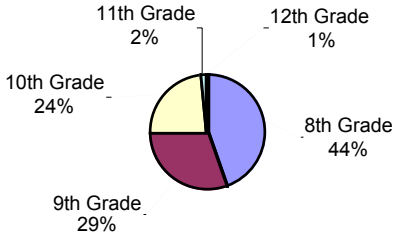


Figure 82. EYH attendance by grade.

Teacher Conference. The Laboratory places a high value on the influence of teachers on career choices made by students. In recognition of that value, teachers who accompanied their students to EYH02 were invited to participate in Teacher Conference 2002, a separate same-day event. As in the past, the Laboratory's Education Program Office sponsored this event. Fourteen teachers and two nonteachers attended in 2002.

The teacher conference featured a variety of informative demonstrations, discussions, and hands-on workshops presented by Laboratory

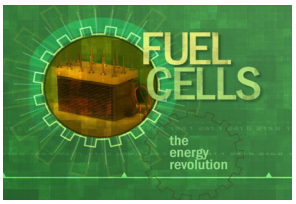
technical staff members and community educators and professionals. The 2002 conference featured workshops on "Spills and Ripples" (science demonstrations about the properties of fluids), "Measuring the Rebound of Sports Balls," and "Reef News." (Reef News® is a nonprofit educational and research organization dedicated to teaching students of all ages about the oceans and their shores. To visit the ReefNews website, go to http://www.reefnews.com/reefnews.) The participants also learned about the Laboratory's "Adventures in Supercomputing" program and the "New Mexico Math Counts" program.

At the completion of the planned activities, the adult sponsors rejoined their students for the keynote address.

Evaluation. The declared ethnic/gender breakdown for those attending the conference was as follows: one Anglo male; eight Anglo females; and seven Hispanic females. Those attending were asked to rate the presentations and the overall conference on a scale of 1 to 10, with 1 being low (didn't meet expectations at all) and 10 being high (exceeded expectations). The overall rating for the conference was 9.

Selected Sound Bites. Following are some of the comments participants made about the program:

- *"Thanks for the resources and demonstrations. Thanks also for the new contacts!"*
- *"I have attended countless 'teacher days' of various descriptions; this was by far the best—well organized, active, busy, engaging and well fed. Thanks!"*
- *"This was excellent, and I'm glad to pass the science on to our young women."*



Fuel Cell Video Documentary

Program Description. In May 1999, the Office of Advanced Automotive Technologies (OAAT) at the Office of Transportation Technologies directed the Fuel-Cell Education Project at Los Alamos National Laboratory (the Laboratory) to develop and produce a video on fuel cells.

The video, *Fuel Cells—The Energy Revolution*, was completed and approved in August 2002.

The scope of the video is international. Viewers learn about the work being done in the United States (U.S.), Europe, and Japan. Demonstration projects shown in the video include the Desert Research Institute sustainable energy system, the Icelandic project to develop a hydrogen energy economy, the Chicago Transit bus project, and the London taxi service plan. Transportation, utilities, and portable power applications for fuel cells are described.

The video was produced at the Laboratory, and Cambridge Documentary Films (CDF) served as the primary consultant. CDF has been making films about social issues for more than 20 years. Its numerous achievements include an Academy Award®. Its films have been presented at film festivals around the world and have reached thousands of students, educators, community leaders, and concerned citizens.

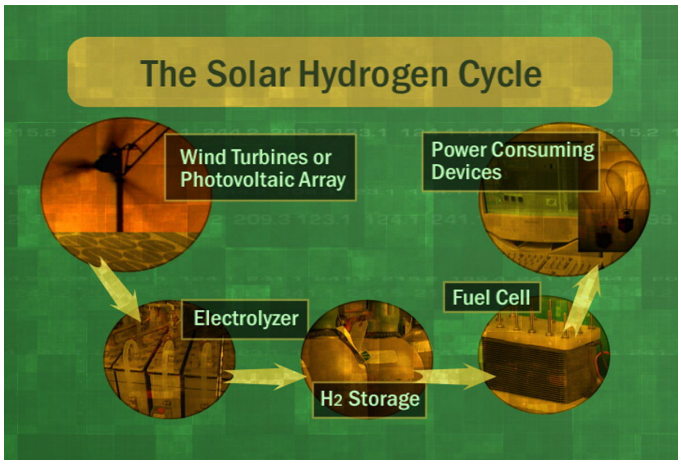


Figure 83. Renewable regenerative fuel cell that uses solar energy to produce power.

The video makes the viewing public aware of the numerous applications of fuel-cell technology as well as the benefits of the technology.

The automobile changed the industrial and social fabric of the U. S. and most other countries around the globe. Henry Ford epitomized "Yankee ingenuity," and the Model T Ford helped create the spirit of the open road, stretching out toward new horizons. The automobile made use of what was once abundant and inexpensive gasoline—but it also created tailpipe exhaust.

Today, more people are driving more cars than ever before. More than 200 million vehicles are on the road in the U.S. alone. The car has contributed to air and water pollution and forced Americans to rely on imported oil, helping to create a significant trade imbalance. As a result, many people think fuel-cell technology will play a pivotal role in a new technological renaissance—just as the internal combustion engine vehicle revolutionized life at the beginning of the 20th century. Figure 83 shows a renewable regenerative fuel cell. Such innovation would have a major global environmental and economic impact.

The primary focus of the video is the use of fuel cells in transportation. Viewers see that fuel cells are not just laboratory curiosities. There is much work that needs to be

done to optimize the fuel-cell system. (The gasoline internal combustion engine is nearly 120 years old and still being improved.) But hydrogen-fuel-cell vehicles are on the road—now. Viewers see commuters living in Chicago who ride on fuel-cell buses. They also get a preview of a fuel-cell motor scooter that is about to make its debut in Taiwan.

In addition, the video shows that every major automobile manufacturer in the world is developing fuel-cell vehicles. The introduction of fuel cells into the transportation sector will increase fuel efficiency, decrease foreign oil dependency, and serve as an important strategy/technology to mitigate emissions concerns.

Viewers also learn about additional applications for fuel cells—including applications in office buildings and homes, and applications in meeting portable-power requirements in devices such as laptop computers and cellular phones.

Performance Goal, Objectives, and Milestones. The goal of the video is to inform a general audience about the benefits of fuel-cell technology and show the exciting and diverse opportunities the technology holds for the future.

During FY02, postproduction efforts were completed at Context Media in Providence, Rhode Island.

OAAT at the Department of Energy asked that all mention of climate change and carbon dioxide emissions be removed from the video. It became necessary to reedit sections of the video and rewrite sections of the narration to accommodate this directive. After these changes were made, there were extended delays in receiving final approval of the video because of extensive reviews within OAAT and the Public Affairs Office at the Energy Efficiency and Renewable Energy Office.

Nevertheless, final review and approval came in August 2002.

Highlights of This Year's Accomplishments. The following people are included in the video: H. Watanabe, member of board, Toyota; Dr. Alan Lloyd, president, California Air Resources Board; Joan Ogden, professor, Princeton University; Paul MacCready, president, Aerovironment; John Wallace, Ford Motor Company; Harry Pearce, former vice chairman of the board, General Motors; Frank Kruesi, director, and two other individuals—a mechanic and a bus driver—at the Chicago Transit Authority; Christopher Galvin, chief executive officer, Motorola; Glenn Rambach, a student at Desert Research Institute; Bill Poldony, retired, International Fuel Cells; William Miller, chief executive officer, UTC Fuel Cells; Georg Burkhardt and students (German teacher and students); Jon Bjorn Skulason, Iceland New Energy Project; Don Huberts, chief executive officer, Shell Hydrogen; Shimshon Gottesfeld, chief technical officer, MTI Micro Fuel Cells; Andrew Brown Jr., Delphi Automotive; Tom Gross, deputy assistant secretary, Office of Transportation Technologies, U.S. Department of Energy; and Graham Batchelor, Houston Advanced Research Institute.

The video was approved for distribution in August 2002, and a draft distribution plan for the video has been prepared for OAAT. The plan includes the following items: the video premiere, U.S. distribution, international distribution, a study guide, and computer-based and electronic distribution. Distribution efforts will begin in FY03.

Fuel Cell Tutorial

Program Description. In October 1999, a 36-page, four-color publication, *Fuel Cells—Green Power* was published. This activity began in May 1998, when the Fuel Cell Education Project at the Laboratory received funding from the Office of Advanced Automotive Technologies (OAAT) at the Office of Transportation Technology in the U.S. Department of Energy to develop a tutorial for high school and college students on fuel cells. The 3M Foundation also supported this work through a financial contribution.

The publication remains a popular and respected addition to educational efforts on the subject.

Performance Goals, Objective, and Milestones. An important objective of this effort has been to make the publication available to a wide audience, using the following techniques:

- developing a "standalone" publication containing detailed and up-to-date information on current developments in fuel-cell research and technology;
- stimulating independent inquiry by providing appropriate follow-up resources; and
- creating an engaging and visually attractive brochure.

Highlights of This Year's Accomplishments. A few of this year's accomplishments are reported in the following list:

- The publication has gone into its fourth printing, and more than 40,000 copies have been distributed worldwide.
- High school and college students from around the globe have requested copies of the publication.
- Thousands of copies have been requested by industry. Major automobile manufacturers, fuel-cell companies, and suppliers are distributing the publication to their newly hired staff members involved in fuel-cell research and development areas.
- The publication has been translated into Japanese, German, and Spanish.

Tutorial-Based Website

Program Description and Accomplishments. *Fuel Cells—Green Power* is also available on the internet at http://education.lanl.gov/resources/fuelcells in pdf format for easy and convenient downloading. The site receives approximately 7,500 hits per month. Hyperlinks to references and resources are included in the text. E-mail comes from around the world from students as well as businesses. Laboratory responses provide information, references, and referrals. Technical experts occasionally assist in ensuring complete and accurate answers.

Los Alamos Educational Equipment Gift Program

Program Description. The Los Alamos Educational Equipment Gift Program (LEEG) for FY2002 (FY02) was an ongoing effort between the national educational and nonprofit communities and Los Alamos National Laboratory (LANL, the Laboratory). The purpose of the program was to dispose of research equipment that was excess to the Laboratory and the Department of Energy (DOE) by giving it to an educational institution and/or a nonprofit organization for the conduct of technical and scientific education or research. The program complemented the DOE Energy-Related Laboratory Equipment (ERLE) Program, the New Mexico Federal Surplus Program, and the Laboratory's K-12 Equipment Gift Program, and it enabled the Laboratory and DOE to assist all deserving educational organizations in a fair and efficient manner. Program implementation and administration followed the approach and guidelines developed for, and effectively implemented by, the Laboratory's successful K-12 Equipment Gift Program.

The Science and Technology Base/Education Program Office (STB/EPO) is the Los Alamos Education Equipment Gift Program (LEEG) primary administrator/coordinator and the point of contact (POC). STB/EPO and the Business Operations Division jointly manage the LEEG. The POCs have the following responsibilities:

- They receive all gift requests,
- They conduct initial request reviews,
- They are responsible for all reporting requirements, statistical information gathering, record keeping, and document retention,
- They act as subject-matter experts on all matters related to the LEEG,
- They inform and instruct Laboratory workers about the program's objectives and guidelines,
- They inform interested institutions about the program, and
- They notify institutions, by letter, about the "intent to gift."

Project Goal, Objectives, and Milestones. The LEEG program seeks to leverage the Laboratory's scientific capabilities and resources by providing excess equipment to enhance educational activities in the scientific, mathematical, and engineering fields. The LEEG committee is the governing body for the program. It is led by STB/EPO and represented by Property Management (BUS-6), a technical representative, and Johnson Controls Northern New Mexico Property Management. The committee is the sole Laboratory delegation that awards gifts through the program. The committee is responsible for the following tasks:

- ensuring that requests for gifts are complete;
- reviewing requests for eligibility;
- awarding requests;
- documenting the justification for gifts;
- developing and administering an awards initiative for the program;
- recognizing organizations for support of the program;
- ensuring fairness; and
- ensuring program compliance with established guidelines.

During FY02, Laboratory managers ensured that their cognizant organizations actively participated, supported, and endorsed the LEEG by

- informing the committee of available equipment that should be considered for the program;
- notifying the program administrator or the committee of any scheduled project shutdown;
- identifying a technical representative who could assist the committee in determining the availability of equipment; and the condition, capabilities, and appropriateness of property for giving. (The technical representative must gather and keep all operating manuals associated with designated gift equipment.)

Highlights of this Year's Accomplishments. LEEG equipment gifts in FY02 totaled $2,153,715. More than 30 organizations received equipment from the program (Tables 34 and 35).

Table 34. Breakdown of Equipment and Acquired Cost for New Mexico Schools in FY02

Organization	City/State	Acquired Cost (in Dollars)	Equipment Name
Eastern New Mexico State University	Portales, NM	88,335	lab equipment
Ernie Pyle Elementary School	Rio Rancho, NM	26,448	computers, printers
Friends of Farmers Market	Santa Fe, NM	5,959	printer
La Plaza Telecommunity	Taos, NM	1,006	printer
New Mexico Highlands University	Las Vegas, NM	7,000	laser
New Mexico Institute of Mining and Technology	Socorro, NM	271,168	machine tools
New Mexico State University	Las Cruces, NM	76,884	goniometer
Northern New Mexico Community College	Española, NM	15,501	lab equipment
Northern New Mexico Network	Rio Rancho, NM	36,286	computers
Santa Fe Public Schools	Santa Fe, NM	117,870	server
St. Anthony's Indian School	Zuni, NM	28,000	computers
St. Francis Cathedral	Santa Fe, NM	111,978	computers, etc.
University of New Mexico	Albuquerque, NM	273,221	various lab equipment items
	TOTAL	**$1,059,656**	

Table 35. Breakdown of Equipment and Acquired Cost for Out-of-State Schools in FY02

Organization	City/State	Acquired Cost (in Dollars)	Equipment Name
Antonito High School	Antonito, CO	66,672	various lab equipment items
Arizona State University	Tempe, AZ	227,736	microscope, scanning electron microscope
Augustana College	Rock Island, IL	143,000	electron microscope
Boston University	Boston, MA	15,198	test equipment
Brigham Young University	Provo, UT	27,858	laser equipment
California Institute of Technology	Pasadena, CA	9,600	detectors
Duke University	Durham, NC	9,590	microprogrammable branch driver
Louisiana State University	Baton Rouge, LA	2,781	controller
Pennsylvania State University	University Park, PA	38,956	lab equipment
Prairie View A&M University	Prairie View, TX	33,000	chemical vapor deposition
Rensselaer Polytechnic Institute	Troy, NY	18,207	workstation
Stanford University	Stanford, CA	50,234	testing equipment
Texas A&M University	College Station, TX	30,667	ion beam equipment
Universidad del Turabo	Gurabo, PR	27,259	machine tools
University of California-Los Angeles	Los Angeles, CA	146,498	instruments
University of California-Riverside	Riverside, CA	2,375	spectrometer
University of Colorado	Boulder, CO	4,995	remote control
University of Florida	Gainesville, FL	9,000	potentiostat
University of Missouri	Rolla, MO	69,560	chromatograph
University of Notre Dame	Notre Dame, IN	50,000	detector
Washington and Jefferson College	Washington, PA	50,000	chromatograph
Alfred University	Alfred, NY	60,873	lab equipment computers
	TOTAL	**$1,094,059**	

Los Alamos Space Science Outreach Program

Program Description. The Los Alamos Space Science Outreach Program (LASSO) is a collaborative, ongoing effort between the technical community (the Space and Atmospheric Sciences Group, NIS-1) and the Education Program Office (EPO) at Los Alamos National Laboratory (LANL, the Laboratory). New Mexico contains a significant population of Hispanic and Native American people, traditionally underrepresented in scientific and technical vocations. LASSO has contributed directly to LANL efforts to reach out effectively to this population (Table 36).

LASSO was designed to provide current science curricula and to decrease isolation for teachers in rural areas through creative use of the World Wide Web (http://set.lanl.gov/programs/lasso/). The program focuses on current National Aeronautics and Space Administration (NASA) projects exploring the composition of the solar system.

The LASSO project engages master teachers in sustained learning activities directly tied to the NASA-LANL space science programs, thus supporting improved science, math, and

Table 36. Demographics. This table shows the breakdown of the LASSO participants by gender, ethnicity, location, population served, and academic level taught.

Gender Breakdown:			
Total Male Participants		3	42.9%
Total Female Participants		4	57.1%
	Total	7	100%
Ethnicity Breakdown:			
Total Caucasian		4	57.1%
Total Hispanic		3	42.9%
Location Breakdown:	**Population Served**	**Level**	
Mora	Hispanic	Elementary	
Alcalde	Hispanic	Elementary	
Cleveland	Hispanic	Elementary	
Farmington	Anglo	Secondary	
Los Lunas	Anglo	Secondary	
Melrose	Anglo	Elementary/Secondary	
Lovington	Anglo	Elementary	

technology content knowledge as well as lifelong learning process skills. The LASSO science education effort adheres to an effective instructional model based on education research and cognitive theory. Through this program, students and teachers engage in activities that encourage critical thinking, a constructivist approach to learning, research, reflection, cycles of inquiry, and iterative assessments over the life of a project (Figure 84).

Figure 84. Dr. Michelle Thomsen (NIS-1) discussing analysis of solar data.

The educational component of this project involves master teachers representing secondary and elementary school levels in the development of multidisciplinary and multilevel classroom lessons and activities that focus on the NASA projects through a collaborative, distance-learning process. The master teachers enhance their use of computer technology through the development of skills in web page creation, concept mapping, and Internet research. The teachers interact with LANL mentors throughout the program.

During the program, teachers critically investigate the LASSO projects through the examination of basic and advanced science concepts behind the project goals. LANL mentors from NIS-1 collaborate with the master teachers, providing current science content, motivation, and support. The master teachers learn how scientific data are collected, analyzed, and interpreted. They learn effective instructional methods that are incorporated into effective web-based lessons and activities published on the LASSO educational web site.

The master teachers continue collaborative efforts through telecommunications during the research and development phase. They participate in a culminating activity where they complete and deliver their web-formatted lessons and activities for the LASSO web site.

Performance Goals, Objectives, and Milestones. The LASSO program leverages the Laboratory's scientific capabilities and resources by integrating current research in the area of space physics. The LASSO project supports the NASA education mission by aligning with the following NASA goals:

- increase public understanding of the issues relating to the future of space exploration;
- develop the connections between scientific concepts and everyday life;
- increase understanding of the scientific process;
- provide opportunities to develop and apply critical thinking and problem-solving skills on complex problems of scientific significance; and
- promote cooperative learning through successful teamwork.

The project was designed to enhance the overall quality, scope, and realism of science, mathematics, and technology education in New Mexico schools by achieving the following objectives:

- increasing teachers' and students' knowledge of the science, math, and technology involved in space physics;
- enhancing teachers' skills in teaching the content of earth and space sciences and the newest exciting technologies;
- providing hands-on activities and materials that can be utilized in the schools;
- exposing teachers and students to the application of earth and space science to current and future research projects at national laboratories; and

- providing a mechanism for teachers to encourage students to pursue careers in earth and space science.

Implementation. In FY2002, a select team of seven master teachers representing secondary and elementary schools in New Mexico were selected to participate in space science workshops held at the Laboratory. The master teachers worked together with laboratory scientists to develop appropriate curricula for their educational communities. Scientists participated in the workshops by identifying basic concepts of space and planetary sciences while introducing new technologies behind current and future explorations. The teachers developed and implemented appropriate activities in their classrooms. The teacher-developed, scientist-directed, student-oriented units were inquiry-driven and modeled on sound pedagogical practices. These practices included the constructivist learning theory, cooperative and collaborative learning relationships, and the integration of mathematics, science, and technology content. The teacher-prepared materials were published on the LASSO web site, thus furthering the impact on a wider community.

Program quality was ensured in the following ways:

- **Workshops.** The LASSO program was designed to match Laboratory expertise with the needs of schools in New Mexico in order to provide a unique educational opportunity tied to the NASA mission. LANL program staff members met with teachers in a series of workshops to develop scientific content and promote an effective curricular approach. The workshops demonstrated provisions of instruction for teachers in process and content and the application of resources that required the teachers to sharpen their critical-thinking and problem-solving skills on current, real, space-science projects.
- **Products.** Each teacher produced products for dissemination based on his/her work on the project areas (Advanced Computer Explorer, Cassini, Two Wide Angle Imaging Neutral Atom Spectrometers, Global Positioning System/Environmental Earth Science Information System, Mars Instrument Development Program, Imager for Magnetopause to Aurora Global Exploration, and the Lunar Prospector). The teachers examined specific projects conducted by NIS-1 and worked to develop educational products. These educational products included grade-level-specific lessons and activities. Products were produced for the elementary, middle school, and high school levels. Examples from the new lessons and activities include The Heights of Space, Planets, Solar System Exploration, The Lunar Prospector, The Full Moon, and Computer Applications for Planetary Science. These and previous activities are listed on the LASSO web site and can be accessed at http://set.lanl.gov/programs/lasso/standards.html.

Evaluation. The program evaluation tools included process feedback forms and teacher surveys. Follow-up activities were conducted throughout the academic year while teachers implemented a variety of LASSO lessons. Teachers were expected to assess their implementation through the evaluation of student papers, student presentations, and student-prepared products. The teachers submitted final reports during the spring semester.

Review of the teacher surveys showed that the project was successful in meeting its overall goals. The teachers enjoyed interacting while conducting their research and completing their LASSO lessons and activities during LASSO workshops. Teachers generally agreed that the students learned a lot about the topic. (Please see the anecdotal comment section.)

Evaluation of the program using a variety of tools and methods revealed that students and teachers demonstrated positive increases in the following areas:

- understanding of space physics;

- understanding of the monitoring of space phenomena;
- understanding of telecommunications;
- use of technology for research purposes;
- use of computers to communicate and share information with others;
- understanding of in-depth research of complex issues;
- use of concept mapping; and
- understanding of content by using a problem-based approach to learning science.

Milestones for FY02 are detailed in Table 37.

Highlights of This Year's Accomplishments. The first workshop was held at the Laboratory the week of July 8, 2002. During that week, seven master teachers began developing classroom lessons and activities that supported the LASSO curriculum efforts in space physics. Teachers were immersed in the NIS-1 projects included in the LASSO effort. Project scientists discussed some of the basics included within their research. Seminars included lectures and demonstrations on particle physics, charged particles, and electromagnetic fields. Further studies acted as a background for advanced sessions on the solar wind and Earth's magnetosphere.

The second workshop was held at the Laboratory the week of July 15, 2002. Seven master teachers representing six New Mexico school districts and seven individual schools participated in the summer institute. The teachers developed curricula and established a communication network to share and disseminate curriculum ideas, thus reducing their isolation from the rest of the educational community. Laboratory scientists participated as content mentors and offered opinions and space physics experiences.

The third and final workshop was held at the Laboratory the week of August 5, 2002. Seven schools and seven teachers participated. Three high schools, one middle school, and three elementary schools were represented. The projected overall student enrollment supervised by the seven teachers was approximately 600.

The master teachers used the Web Quest curriculum model developed by Bernie Dodge at San Diego State University to develop curricula. The teachers became very comfortable using technology, and it was expected that their students would use technology in class.

Anecdotal Comments from Teachers. Following are comments made by several of the teachers who participated in the program.

"Our class met as often as it could in the computer lab to have research experience with the web page on space weather. We used alternate class time to discuss and investigate related ideas and concepts."

"The students' ability to grasp these concepts and wrestle with more complex ideas in physics surprised me. To say they were enthusiastic about this study is an understatement."

Table 37. Milestones. This table lists the deadlines met in the fiscal year 2002 LASSO program.

Date	Activity	Accomplishment
May 2002	Recruit FY02 cohort	Recruited seven participants
July 2002	Hold workshop #1 on science content	Conducted workshop July 8–11, 2002
July 2002	Hold workshop #2 on science and pedagogical content	Conducted workshop July 15–18, 2002
August 2002	Hold workshop #3, the wrap-up session	Conducted workshop August 5–8, 2002
August 2002–April 2003	Complete implementation and reporting	Completed program and submitted report

"I was so pleased by the amount of enthusiasm that my students showed for this unit. The ideas that we as teachers were able to deliver to our students because of the LASSO project were fresh and intriguing to my students. I keep saying that I was surprised by their response because I have never seen students so involved and interested in a science subject before." (See Figure 85.)

Figure 85. Fifth-grade students studying the magnetosphere and auroras.

"I am glad that I was able to take part in this project because both my students and I learned a great deal about how learning can be placed in the hands of the students and driven by their curiosity."

"The LASSO program was one of the best-run projects that I have attended. I felt that my time was never wasted because the lessons taught by the NIS scientists were at a level that I could grasp and gradually build upon throughout each session." (See Figure 86.)

"Throughout the three-week Los Alamos Space Science Outreach program, I learned a tremendous amount of information about space."

"For the majority of my students (kindergarten level) this was their first experience with the Internet. They LOVED how interactive it was and how they had to figure out a mystery."

"I was a little nervous presenting this enormous amount of information to 5- and 6-year-olds, but they eased my mind quickly as they shared with me their understanding, and sometimes misunderstandings, about space and the sun. As we began the unit, books flooded our classroom from children who were excited about this topic."

Figure 86. LASSO teachers analyzing solar data.

"Overall, I was pleased with how my students and parents reacted to this project. It was obvious in the student enthusiasm and the parent comments that they appreciated and enjoyed the topic of study."

"Students were motivated by the spectacular photos found on the web quests. The excitement in the computer lab was inspiring to see and hear as a teacher. Comments like 'Look at this!' 'Did you know?' and 'I didn't know that!' put enthusiasm into the project."

"When starting the project, I thought the project might be bigger than the students could handle. When the daily group discussions began, I could hear that the understanding of the topic was coming along just fine. I could also see the excitement of using web quests as a tool to investigate, collect data, and listen to video and audio aids as a positive change over teachers lecturing about abstract ideas."

"Working with others of like backgrounds in education was an experience that was invaluable as well. It is not often that teachers can get together and learn about such topics and find the time to collaborate and synthesize information. The LASSO program provided this opportunity."